

# JAPAN

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JIS Z 9120 (1995) (English): Lighting for outdoor tennis courts and outdoor baseball fields

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*The citizens of a nation must  
honor the laws of the land.*

Fukuzawa Yukichi

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# JIS

**JAPANESE INDUSTRIAL STANDARD**

**Lighting for outdoor  
tennis courts and  
outdoor baseball fields**

**JIS Z 9120—1995**

**Translated and Published**

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## JAPANESE INDUSTRIAL STANDARD

J I S

Lighting for outdoor tennis courts  
and outdoor baseball fields

Z 9120-1995

1. Scope This Japanese Industrial Standard specifies lighting for outdoor tennis courts and outdoor baseball fields.

Remarks: The following standards are cited in this Standard:

JIS C 1609 Illuminance meters

JIS C 7612 Illuminance measurements for lighting installations

JIS Z 8113 Glossary of lighting terms

2. Definitions For the purpose of this Standard, the definitions specified in JIS Z 8113 apply.

3. Necessary conditions for lighting

3.1 Matters for investigation in planning When lighting for outdoor facilities is planned, the following items shall be investigated in advance.

- (1) Structure of facilities Shapes and dimensions of facilities; number, quality of materials, colours and reflectance of fields and the like; whether there is fence and, if any, its arrangement, structure, dimensions, colours, reflectance, position possible to be equipped with lighting fixtures, etc.
- (2) Purpose of use Distinction of uses for games and recreation and distinction between cases to take television pictures or not.
- (3) Environment of facilities Whether or not residential area, road, railway, airport, etc. are nearby and their positional relation.
- (4) Meteorological conditions Condition of snow fall, damage from salt rain and wind verocity.
- (5) Situation of power supply Electric system, service voltage, frequency, capacity, etc.

3.2 Design of lighting When lighting is designed, the following items shall be taken into consideration.

- (1) Illuminance and its uniformity ratio The sports ground shall be provided with a sufficient illuminance having a good uniformity ratio.

- (2) Glare The glare which stems directly from the lighting fixtures shall be minimized as far as possible, so that the game is not much interfered thereby.

Moreover, in the facilities where the professional or official games are played, the unpleasant glare should be reduced as far as possible.

- (3) Stroboscopic effect When a discharge lamp is lighted by power frequency (50 Hz or 60 Hz), a stroboscopic effect shall be minimized as far as possible.
- (4) Light source A suitable light source shall be selected, taking the following items into consideration.
- (a) Lamp efficiency (in the case of discharge lamps, overall efficiency including the ballast loss).
  - (b) Service life and luminous flux maintenance factor
  - (c) Light source color and color rendering properties
- (5) Others The following items shall also be considered.
- (a) Selection of construction materials and construction method suitable for natural environment.
  - (b) Easiness of maintenance and management
  - (c) Economical aspects
  - (d) Fine view
  - (e) Safety illumination
  - (f) Spare circuit

#### 4. Criteria for lighting

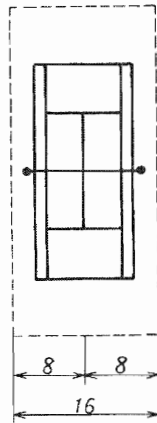
##### 4.1 Lighting for tennis courts

4.1.1 Lighting area The lighting area of a tennis court shall be the entire ground used for the tennis game surrounded by a fence or a stand. However, when the illuminance is to be measured and evaluated (setting of illuminance, measurement of illuminance, calculation of illuminance uniformity ratio, and the like), the object area shall be as given in Fig. 1.

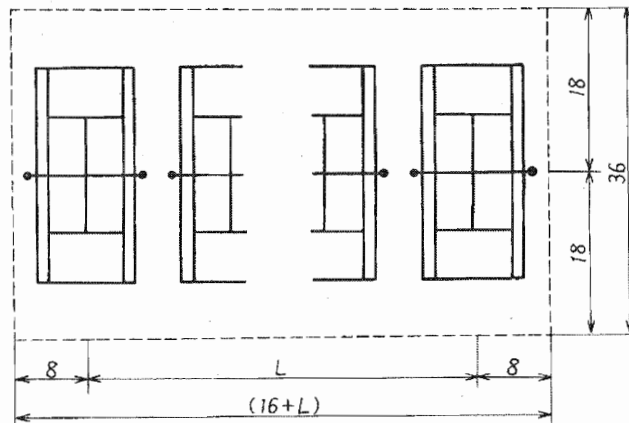
Fig. 1. Object area of measurement and evaluation

Unit: m

(a) Single court ground



(b) Two or more court ground



4.1.2 Illuminance and uniformity ratio The average illuminance on the surface of tennis courts (the illuminance on a horizontal plane) and its uniformity ratio shall be as shown in Table 1.

Measuring method for illuminance shall be as shown in Annex.

Table 1. Average value and uniformity ratio of illuminance on horizontal plane

Type of game	Illuminance on horizontal plane	
	Average value lx	Uniformity ratio <sup>(1)</sup>
Official game <sup>(2)</sup>	1000 min.	0.65 min.
General game <sup>(3)</sup>	500 min.	0.50 min.
Recreation <sup>(4)</sup>	250 min.	0.50 min.

Notes <sup>(1)</sup> Uniformity ratio of illuminance on horizontal plane shall be calculated by the formula (1):

$$U_h = \frac{E_{h \min}}{E_{h \text{ ave}}} \dots \dots \dots (1)$$

where,  $U_h$  : uniformity ratio of illuminance on horizontal plane

$E_{h \min}$  : minimum value of illuminance on horizontal plane (lx)

$E_{h \text{ ave}}$  : average value of illuminance on horizontal plane (lx)



- (<sup>2</sup>) Game the result of which is kept as an official record.
- (<sup>3</sup>) Game other than the official game.
- (<sup>4</sup>) Sports for enjoying leisure time or improving health.

Remarks: For illuminance and uniformity ratio for taking television pictures, see clause 5.

4.1.3 Arrangement of lighting fixtures In the lighting for tennis courts, lighting fixtures shall be arranged, as a rule, parallel to the side lines of courts. However, when many courts are arranged continuously side by side, the lighting fixtures may be arranged on the middle position between the courts behind the base lines and on the neighbourhood of boundary between every court, parallel to the side line when every two courts are situated in tandem. Examples of arrangements of lighting fixtures are shown in Fig. 2.

Fig. 2. Examples of arrangements of lighting fixtures

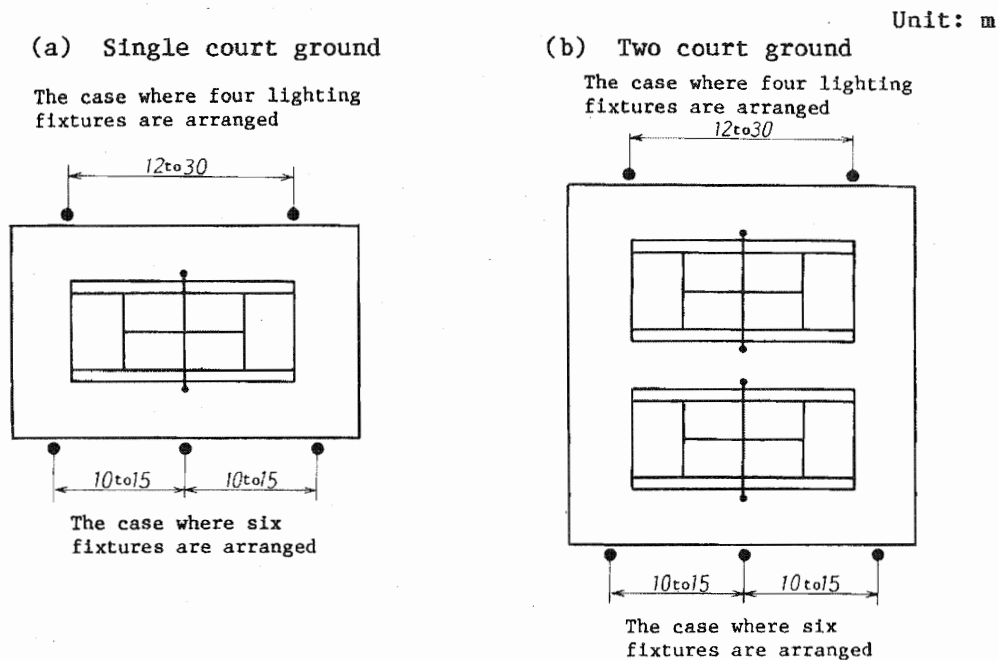
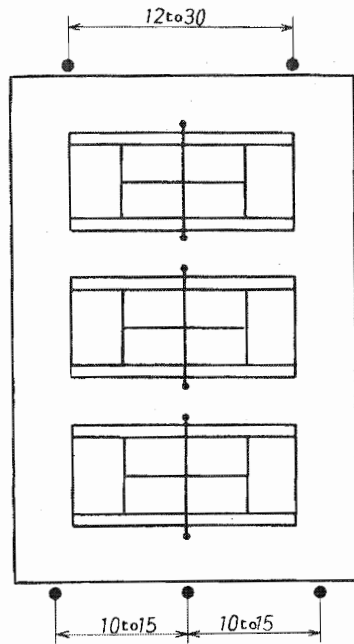


Fig. 2. (continued)

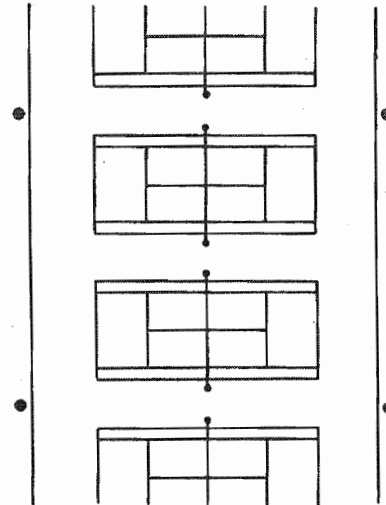
(c) Three court ground

The case where four lighting fixtures are arranged



The case where six fixtures are arranged

(d) Continuous four and over court ground



(e) Court where every two courts situated in tandem

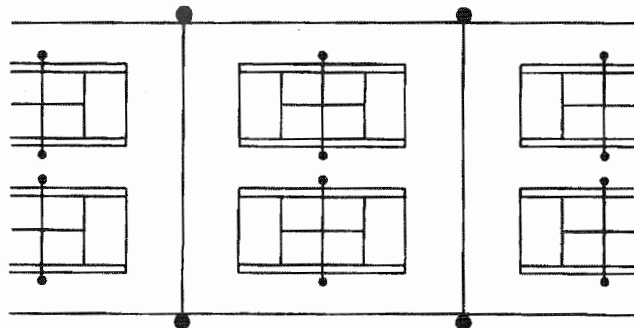
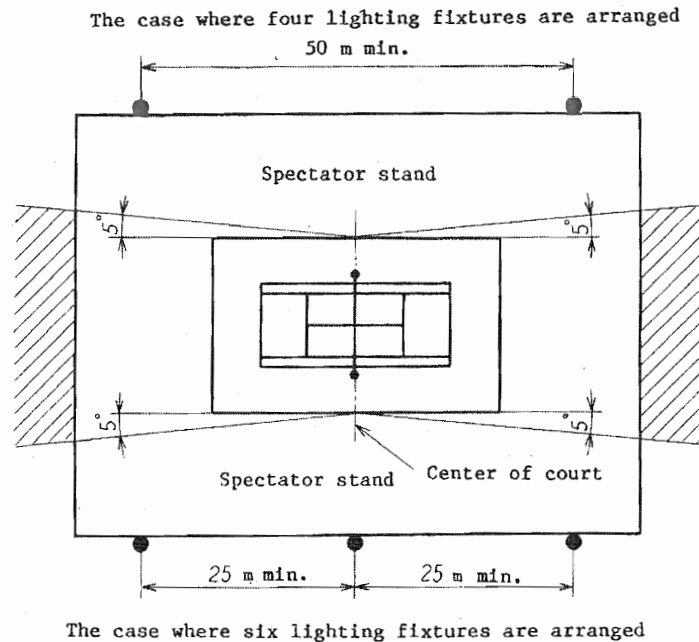



Fig. 2. (continued)

(f) Court where television pictures are taken



- Remarks 1. Mark ● indicates installation position of a lighting fixture.
2. Mark  indicates an area where lighting fixture shall the lowest stage of not be installed.

4.1.4 Mounting height of lighting fixtures The mounting height of the lowest stage of the lighting fixtures in tennis courts shall be determined by the formula (2) or (3).

(For official game and general game)

$$H_1 \geq 7 + 0.4 L \dots \dots \dots (2)$$

However, the minimum height shall be 12 m.

(For recreation)

$$H_2 \geq 3 + 0.4 L \dots \dots \dots (3)$$

However, the minimum height shall be 8 m.

where,  $H_1$  : mounting height of the lowest stage of lighting fixture in the case of official game and general game (m)

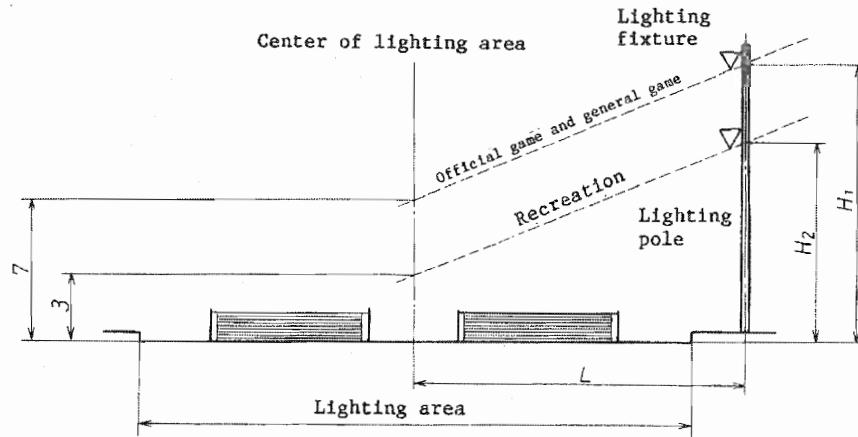
$H_2$  : mounting height of the lowest stage of lighting fixture in the case of recreation (m)

$L$  : mounting interval of lighting fixtures shown in Fig. 3 (a), (b), (c), and (d) (m)

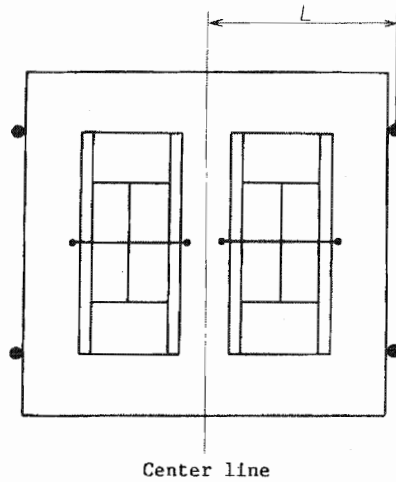
Fig. 3. Mounting height of lighting fixtures

Unit: m

(a) Cross-sectional view (in the case of two court ground)



(b) In the case of arrangement in parallel to side line



(c) In the case of arrangement between the courts behind the base line

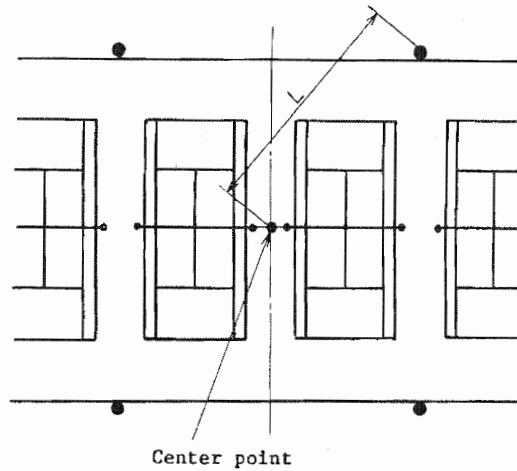
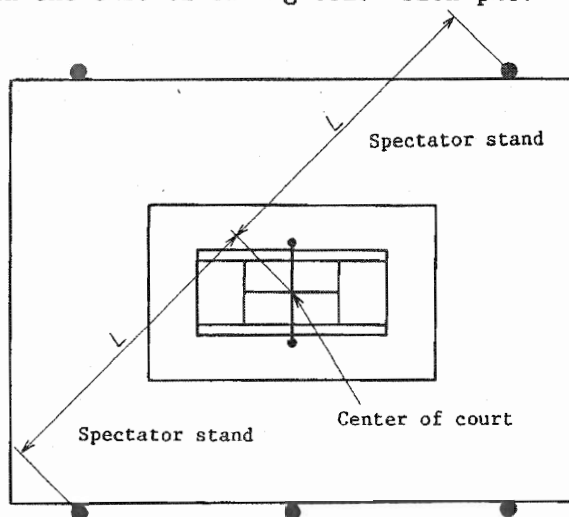


Fig. 3. (continued)

(d) In the case of taking television pictures



Remarks: Mark ● indicates installation position of lighting fixture.

4.1.5 Lighting fixtures Lighting fixtures used for lighting for tennis courts shall be projectors, and shall, as a rule, be selected according to Table 2.

Table 2. Selection of lighting fixture

Type of game	Number of courts	Classification of luminous intensity distribution of projector		
		Narrow-angle luminous intensity distribution <sup>(5)</sup>	Intermediate-angle luminous intensity distribution <sup>(6)</sup>	Wide-angle luminous intensity distribution <sup>(7)</sup>
Official game <sup>(2)</sup>	One	○	◎	
	Two or more	○	◎	
General game <sup>(3)</sup>	One		◎	○
	Two or more	○	◎	○
Recreation <sup>(4)</sup>	One		○	◎
	Two or more		◎	○

Notes <sup>(5)</sup> Projector with the divergence angle of beam of less than 30° (up to 1/10 of the maximum luminous intensity).

<sup>(6)</sup> Projector with the divergence angle of beam of 30° or over up to and excluding 60°.

(<sup>7</sup>) Projector with the divergence angle of beam of 60° or over.

Remarks: ☉: For main use    ○: For auxiliary use

#### 4.2 Lighting for baseball fields

4.2.1 Lighting area The lighting area of a baseball field shall be the entire ground used for the baseball game surrounded by a fence or a stand.

4.2.2 Illuminance and uniformity ratio The average illuminance on the surface of baseball fields (the illuminance on a horizontal plane) and its uniformity ratio shall be as given in Table 3. However, the ratio of the illuminance in the infield to that in the outfield should not exceed 2:1.

Measuring method for illuminance shall be as specified in Annex.

Table 3. Average value and uniformity ratio of illuminance on horizontal plane

Type of game		Illuminance on horizontal plane			
		Average value lx		Uniformity ratio( <sup>1</sup> )	
		Infield( <sup>8</sup> )	Outfield( <sup>9</sup> )	Infield( <sup>8</sup> )	Outfield( <sup>9</sup> )
Hard-ball	Professional game	2000 min.	1200 min.	0.75 min.	0.65 min.
	Official game( <sup>2</sup> )	1500 min.	800 min.	0.75 min.	0.65 min.
	General game( <sup>3</sup> )	750 min.	400 min.	0.65 min.	0.50 min.
Rubber-ball	Official game( <sup>2</sup> )	750 min.	400 min.	0.65 min.	0.50 min.
	General game( <sup>3</sup> )	500 min.	300 min.	0.50 min.	0.40 min.
	Recreation( <sup>4</sup> )	300 min.	150 min.	0.50 min.	0.30 min.

Notes (<sup>8</sup>) The infield said here is defined as an area inside a square having a side of 40 m in length taken from a line 5 m outside from a foul line including the diamond, extending toward the outfield, parallel to that foul line.

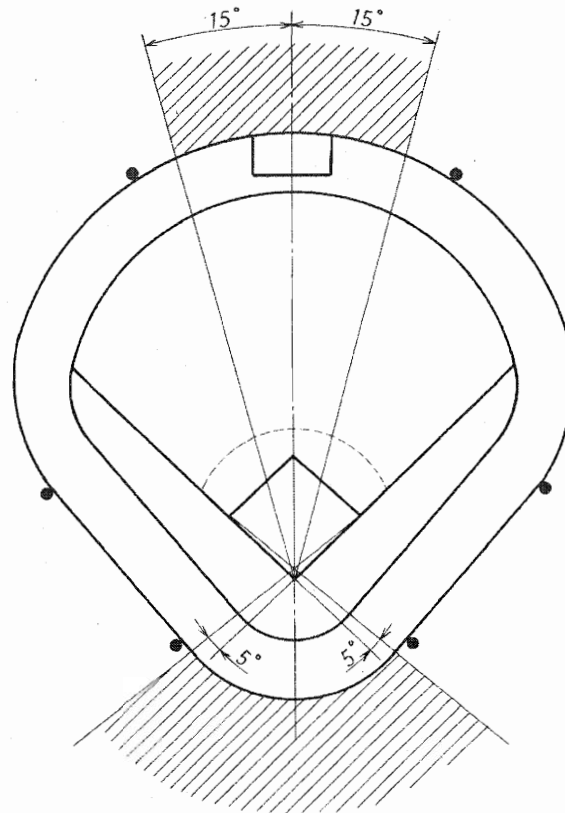
(<sup>9</sup>) The remainder subtracted the area of the infield from that of the entire baseball field shall be considered as an outfield.


Remarks: For illuminance and uniformity ratio for taking television pictures, see clause 5.

4.2.3 Arrangement of lighting fixtures In the lighting for baseball fields, lighting fixtures shall be arranged, as a rule, at six locations as shown in Fig. 4.

The hatched portions in Fig. 4 show the areas where no lighting fixtures shall be installed.

Fig. 4. Arrangement of lighting fixtures



- Remarks 1. Mark ● denotes an installation location of a lighting fixture.
2. Mark  denotes an area where no lighting fixtures shall be installed.

**4.2.4 Mounting height of lighting fixtures** The mounting height of the lowest stage of lighting fixtures in baseball fields shall be determined according to the formula (4). As length  $L$  shown in Fig. 5, a diagonal line between respective positions of the lighting fixtures in the in-and out-fields, whichever is the longest shall be taken. However, when the calculated height can not be secured from various circumstances, the height may be reduced down to 80 % of the calculated value.

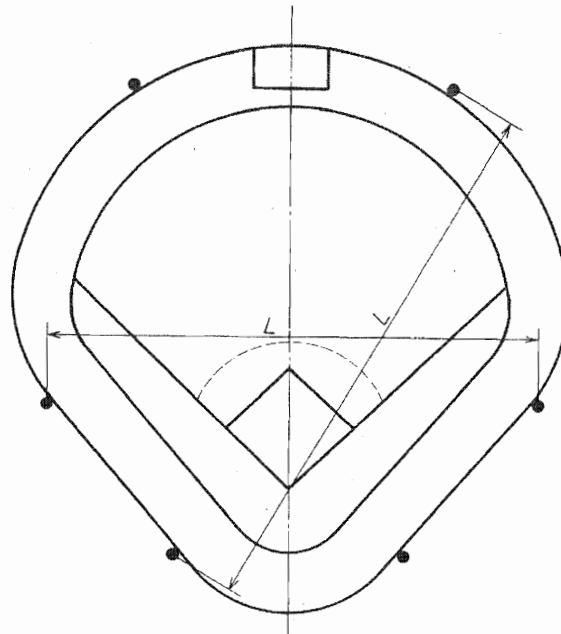
(Mounting height of lighting fixtures)

$$H \geq 0.4 \times \frac{L}{2} \dots\dots\dots (4)$$

where,  $H$  : mounting height of the lowest stage of lighting fixtures (m)

$L$  : interval between lighting fixtures (m)

Fig. 5. Mounting height of lighting fixtures



Remarks: Mark ● denotes an installation location of lighting fixture.

4.2.5 Lighting fixtures Lighting fixtures used for lighting for baseball fields shall be projectors, and shall, as a rule, be selected according to Table 4.

Table 4. Selection of lighting fixture

Type of game		Classification of luminous intensity distribution of projector		
		Narrow-angle luminous intensity distribution <sup>(5)</sup>	Intermediate-angle luminous intensity distribution <sup>(6)</sup>	Wide-angle luminous intensity distribution <sup>(7)</sup>
Hard-ball	Professional game	◎	○	○
	Official game <sup>(2)</sup>	◎	○	○
	General game <sup>(3)</sup>	○	◎	○
Rubber-ball	Official game <sup>(2)</sup>	○	◎	○
	General game <sup>(3)</sup>	○	◎	○
	Recreation <sup>(4)</sup>	○	○	◎

Remarks: ⊙ : for main use    ○ : for auxiliary use



## 5. Lighting for taking television pictures

### 5.1 Lighting for tennis courts

5.1.1 Illuminance and uniformity ratio The illuminance and its uniformity ratio shall be the values shown in Table 5.

The measuring method for the illuminance shall be as shown in Annex.

Table 5. Average value and uniformity ratio of illuminance

Classification of illuminance	Average value lx	Uniformity ratio <sup>(10)</sup>
Illuminance on vertical plane <sup>(11)</sup>	1000 min.	0.30 min.
Illuminance on horizontal plane <sup>(12)</sup>	1000 min.	0.50 min.

Notes <sup>(10)</sup> Uniformity ratio shall be calculated by formulas (5) and (6).

Uniformity ratio of illuminance on vertical plane

$$U_v = \frac{E_{v \min}}{E_{v \max}} \dots\dots\dots (5)$$

where,  $U_v$  : uniformity ratio of illuminance on vertical plane

$E_{v \min}$  : minimum value of illuminance on vertical plane (lx)

$E_{v \max}$  : maximum value of illuminance on vertical plane (lx)

Uniformity ratio of illuminance on horizontal plane

$$U_h = \frac{E_{h \min}}{E_{h \max}} \dots\dots\dots (6)$$

where,  $U_h$  : uniformity ratio of illuminance on horizontal plane

$E_{h \min}$  : minimum value of illuminance on horizontal plane (lx)

$E_{h \max}$  : maximum value of illuminance on horizontal plane (lx)

<sup>(11)</sup> It means the illumination on vertical plane on the side where the camera is situated, at the height of 1.5 m above ground.

<sup>(12)</sup> It means the illuminance on horizontal plane on the ground.

Informative reference: Illumination of spectator stand: The illuminance on vertical plane at the part adjacent to the ground used for the game in the spectator stand facing the side where the camera is situated, is preferred to be kept at approximately 0.25 times the values specified in Table 5.

**5.1.2 Reduction of flicker** When using a discharge lamp, such measures as to connect to three-phase power source shall be taken in order to reduce the flicker which appears on the television display.

**5.1.3 Light source colour and colour rendering properties** The light source colour and colour rendering properties shall be the values shown in Table 6.

Table 6. Light source colour and colour rendering properties

Light source colour	Within a range of 3000 K to 6000 K in colour temperature
Colour rendering properties	Average colour rendering index of 65 or more

## 5.2 Lighting for baseball fields

**5.2.1 Illuminance and uniformity ratio** The illuminance and uniformity ratio shall be the values shown in Table 7.

The measuring method for illuminance shall be as specified in Annex.

Table 7. Average value and uniformity ratio of illuminance

Classification of illuminance	Average value lx		Uniformity ratio <sup>(10)</sup>	
	Infield <sup>(8)</sup>	Outfield <sup>(9)</sup>	Infield <sup>(8)</sup>	Outfield <sup>(9)</sup>
Illuminance on vertical plane <sup>(11)</sup>	1000 or more	750 or more	0.30 or more	0.30 or more
Illuminance on horizontal plane <sup>(12)</sup>	1500 or more	800 or more	0.50 or more	0.50 or more

Informative reference: Lighting of spectator stand: The illuminance on vertical plane at the part adjacent to the ground used for the game in the spectator stand facing the camera side is preferred to be kept at approximately 0.25 times the values specified in Table 7.

**5.2.2 Reduction of flicker** Subclause 5.1.2 applies.

**5.2.3 Light source colour and colour rendering properties** The light source colour and colour rendering properties shall be the values shown in Table 8.

Table 8. Light source colour and colour rendering properties

Light source colour	Within a range of 3000 K to 6000 K in colour temperature
Colour rendering properties	Average colour rendering index of 55 or more

6. Maintenance and management For the purpose of maintenance and management of the lighting equipment, the following operations shall be carried out periodically.

- (1) Check of the lighting condition
- (2) Exchange of lamps
- (3) Exchange of ballast (limited only to separate type)
- (4) Cleaning
- (5) Check of lighting fixtures
- (6) Check and repairing of lighting poles
- (7) Check and repairing of wiring and switching equipment
- (8) Measuring and recording of illuminance (comply with Annex)

# Annex. Illuminance measuring method

1. Scope This Annex specifies the measuring method for illuminance on horizontal plane and illuminance on vertical plane in tennis courts and baseball fields.

The general matters for illuminance measurement other than those specified in this Annex shall be in accordance with the specification in JIS C 7612.

Besides, the illuminance meter to be used shall be general class AA specified in JIS C 1609 or equivalent or superior in performance.

## 2. Illuminance measuring method

2.1 Measuring area The measuring area shall be as follows:

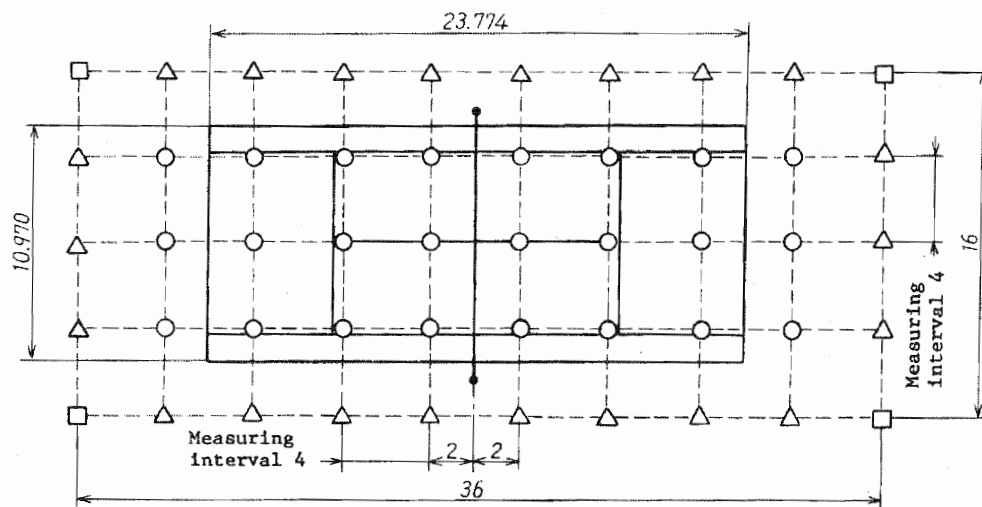
- (1) In the case of tennis courts, the area of 16 m × 36 m including the court at its central portion. When two or more tennis courts are included, the same measuring area shall be set up for each court.
- (2) In the case of baseball fields, the square with outside of lines 5 m distant from the foul line and 40 m extended toward outfield including the diamond. The measuring area of the outfield shall be the entire field surface except the infield.

## 2.2 Measuring points

- (1) For tennis courts, 50 points shown in Annex Fig. 1 shall be taken as a rule.

Annex Fig. 1. Measuring points in tennis courts

Unit: m

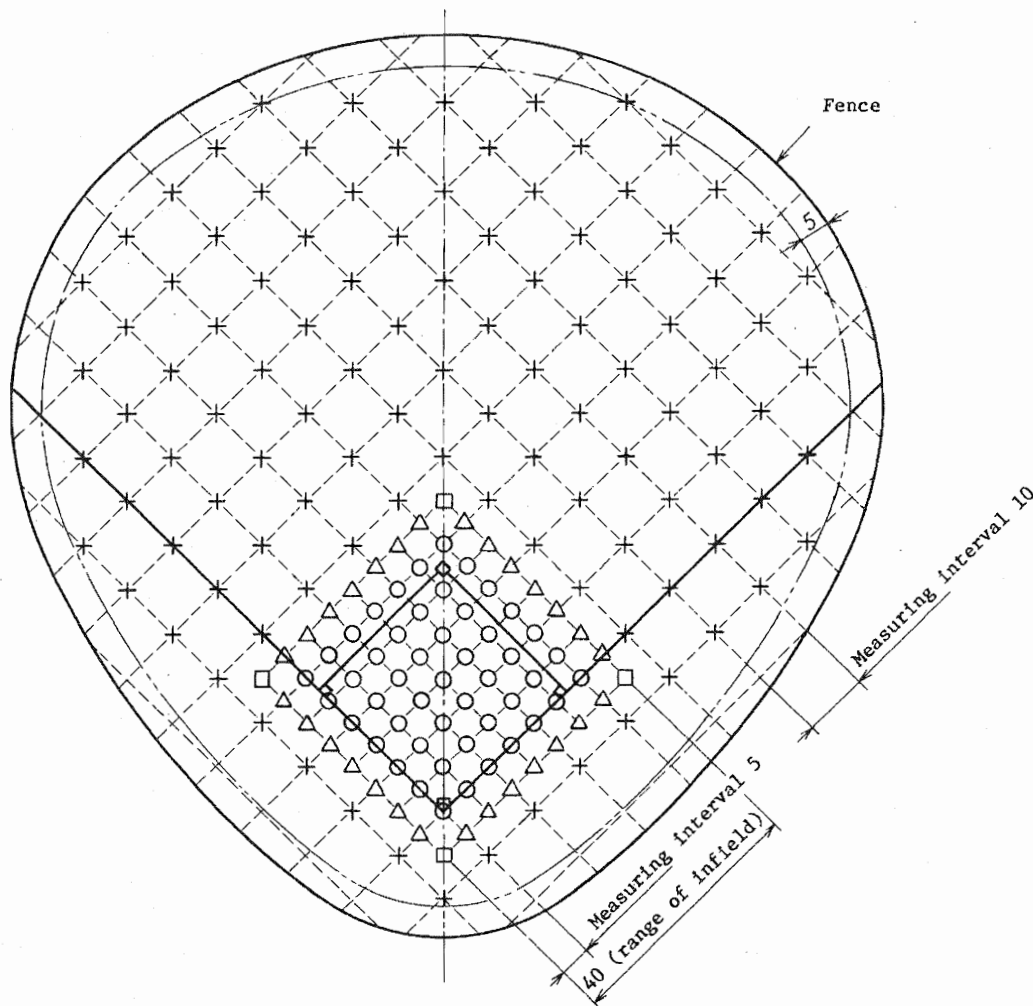


(2) For baseball fields, refer to Annex Fig. 2.

For the infield, take 81 points at 5 m basic intervals and for outfield, take the intersections of each dividing line of basic interval of 10 m which is two times the interval between measuring points in the infield. If the distance between the intersection and the fence is less than 5 m, the measurement is unnecessary.

Annex Fig. 2. Measuring points in baseball fields

Unit: m



**2.3 Measurement of illuminance on horizontal plane** Measure the illuminance on horizontal plane not higher than 15 cm from the ground at the measuring points shown in 2.2.

**2.4 Average value of illuminance on horizontal plane** Calculate the average value of illuminance on horizontal plane by the following formulas:

(1) Tennis courts

$$\text{Average illuminance} = \frac{1}{144} (\sum_{i=1}^4 E_{\square} i + 2 \sum_{i=1}^{22} E_{\Delta} i + 4 \sum_{i=1}^{24} E_{\circ} i) \dots\dots\dots(1)$$

(2) Baseball field

$$\text{Infield average illuminance} = \frac{1}{256} (\sum_{i=1}^4 E_{\square} i + 2 \sum_{i=1}^{28} E_{\Delta} i + 4 \sum_{i=1}^{49} E_{\circ} i) \dots\dots\dots(2)$$

$$\text{Outfield average illuminance} = \frac{\sum_{i=1}^n E_{+} i}{n \text{ (measuring points)}} \dots\dots\dots(3)$$

where,  $E_{\square}$  : illuminance at corner points (lx)

$E_{\Delta}$  : illuminance at points on side line (lx)

$E_{\circ}$  : illuminance at inner points (lx)

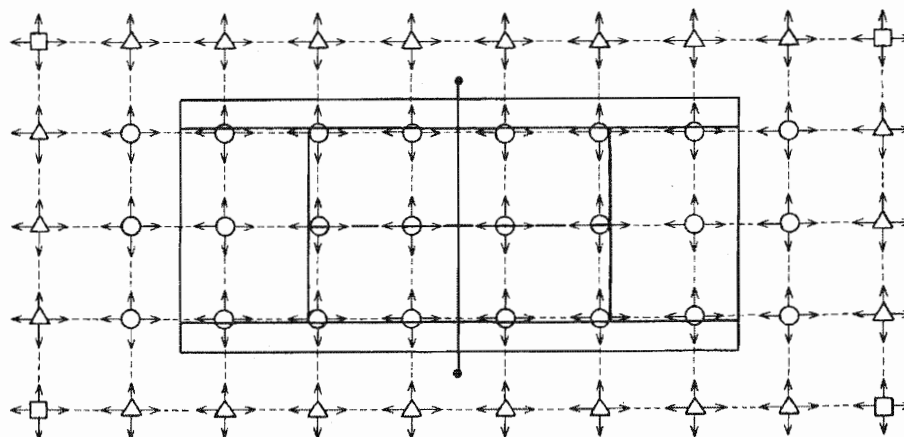
$E_{+}$  : illuminance at measuring points in outfield of baseball field (lx)

2.5 Measurement of illuminance on vertical plane In the ground used for game where television pictures are taken, measure the illuminance on vertical plane at the following measuring points:

- (1) In tennis courts, measure the illuminance on vertical plane 1.5 m high from the ground at the measuring points shown in 2.2.

Measuring directions of illuminance on vertical plane shall be four directions shown in Annex Fig. 3.

Annex Fig. 3. Measuring direction of illuminance on vertical plane (tennis courts)



Remarks: Arrows indicate the direction of light receiving surface of the illuminance meter.



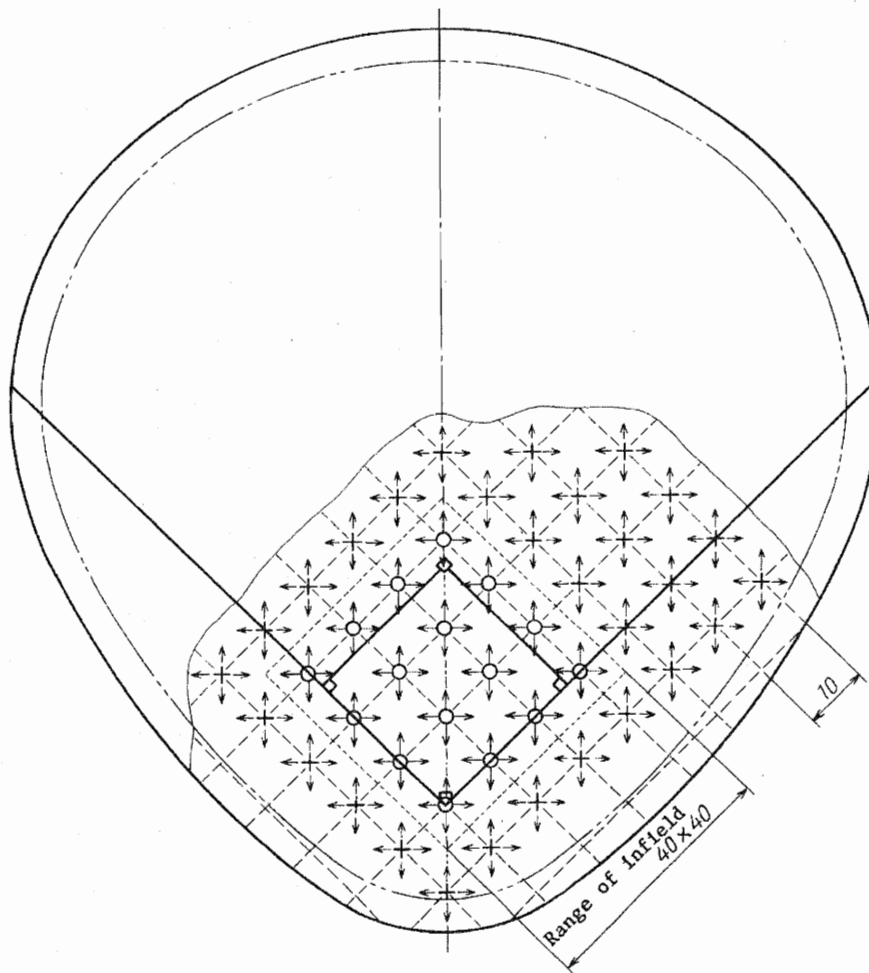
- (2) In baseball fields, of the measuring points shown in 2.2, measure the illuminance on vertical plane 1.5 m high from the ground at the measuring points at 10 m intervals in both infield and outfield as shown in Annex Fig. 4. Measuring directions of illuminance on vertical plane shall be four directions shown in Annex Fig. 4.

Remarks 1. When the lighting facilities and measuring area are symmetrical with respect to the center line, the measurement is carried out only on one symmetrical plane and the measurement on the other plane may be omitted.

2. For the purpose of maintenance and management, several points of representative illuminance may be measured to examine the situation of entire illuminance.

Annex Fig. 4. Measuring directions of illuminance on vertical plane (baseball fields)

Unit: m



Remarks: Arrows indicate the directions of light receiving surface of the illuminance meter.



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